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Religiosity/Spirituality and Mortality

A Systematic Quantitative Review

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Key Words
Body-mind-spirit interaction · Meditation, prayer · Meta-analysis · Positive psychology · Preventive medicine · Religious coping · Well-being

Abstract
Background: The relationship between religiosity/spirituality and physical health has been the subject of growing interest in epidemiological research. We systematically reviewed prospective observational cohort studies of the association between this potentially protective psychological factor and mortality using meta-analytic methods. ***Methods:*** We searched general bibliographic databases: Medline, PsycINFO, Web of Science and PubMed (up to 20 March, 2008). Two reviewers independently extracted data on study characteristics, quality, and estimates of associations. Random effects meta-analyses, subgrouping, and sensitivity analysis were performed. ***Results:*** There were 69 studies (28 articles) and 22 studies (11 articles) investigating the association between religiosity/spirituality and mortality in initially healthy populations and diseased populations, respectively. The results of the meta-analyses showed that religiosity/spirituality was associated with reduced mortality in healthy population studies (combined hazard ratio = 0.82, 95% CI = 0.76–0.87, $p < 0.001$), but not in diseased population studies (combined hazard ratio = 0.98, 95% CI = 0.94–1.01, p = 0.19). Notably, the protective effect of religiosity/spirituality in the initially healthy population studies was independent of behavioral factors (smoking, drinking, exercising, and socioeconomic status), negative affect, and social support. We divided studies according to the aspects of religiosity/spirituality measure examined, and found that organizational activity (e.g. church attendance) was associated with greater survival in healthy population studies. Multi-dimensional aspects were related to survival in both the healthy and diseased populations. Religiosity/spirituality was negatively associated with cardiovascular mortality in healthy population studies. ***Conclusions:*** The current review suggests that religiosity/spirituality has a favorable effect on survival, although the presence of publication biases indicates that results should be interpreted with caution.

Introduction

Religiosity and spirituality can be defined broadly as any feelings, thoughts, experiences, and behaviors that arise from a search for the 'sacred', with the former implying group or social practices and doctrines and the latter tending to refer to personal experiences and beliefs [1]. The term sacred refers to a divine being, divine object, ultimate reality, or ultimate truth as perceived by the individual. A large number of different measures have been used to assess different aspects of religious/spiritual beliefs, practices, motivation, and commitment. Hill and Hood [2] identified more than 125 measurement instru-

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ments in their comprehensive review, and suggested that at least 10 major aspects of religiosity/spirituality could be considered, namely: denomination/affiliation, religious/spiritual belief, religious/spiritual attitudes, organizational or social religious activity, nonorganizational or private religious/spiritual activity, religious/spiritual salience or importance, religious/spiritual orientation or motivation, religious/spiritual coping, religious/spiritual history, religious/spiritual experience, and religious/spiritual development or maturity.

There is an extensive literature relating religiosity/spirituality with mental health [3–7]. For example, a meta-analysis on 49 relevant studies [5] concluded that positive and negative forms of religious coping were related to positive and negative psychological adjustments to stress, respectively. Furthermore, a meta-analysis of 147 studies demonstrated a robust, but modest ($r = -0.096$), negative correlation between religiosity/spirituality and depressive symptoms, due in part to favorable effects on coping with stressful life events [8].

In addition, a growing number of prospective observational studies investigating the relationship between religiosity/spirituality and physical health have been published in recent years. Several reviews of the relationship have been written, but these have limitations. Reviews have been limited to specific aspects of religiosity/spirituality (such as religious attendance and private activity [9]), have not evaluated the type of diseases potentially affected by religiosity/spirituality [9], and have not statistically quantified the extent to which religiosity/spirituality affects physical health using meta-analytic techniques [10–14].

The purpose of this systematic review is to synthesize existing prospective data using meta-analytic techniques to address the following questions:

(1) Is religiosity/spirituality associated with reduced all-cause or specific disease-cause mortality?

(2) Are there differences in the effects of physical health on survival across different aspects of religiosity/spirituality, such as organizational activity (attendance at religious services and involvement in religious communities), religious social support, nonorganizational activity, intrinsic aspects (beliefs in god, religious/spiritual well-being, religious/spiritual experience, and religious motivation/orientation), and coping responses based on religiosity/spirituality?

(3) Do effects vary with causes of death, age, and population characteristics studied? There are potentially important differences between studies involving initially healthy populations and research on patients with diagnosed conditions such as cardiovascular disease and cancer.

(4) What mechanisms are involved in the association between religiosity/spirituality and mortality? Is the benefit of religiosity/spirituality mediated via behavioral pathways such as less smoking, drinking, or more physical exercise? Is it independent of negative affect or social support, because these possible psychosocial mediators are critically involved in health outcomes [8, 15]?

Methods

Data Sources and Searches

We developed a protocol using a standard method for systematic reviews of observational studies [16, 17]. We searched general bibliographic databases: Medline (1966–20 March 2008); PsycINFO (1872–20 March 2008); Web of Science (1900–20 March 2008); PubMed (1950–20 March 2008), and scrutinized reference lists from relevant reviews and articles. The main search strategy was ('mortality' OR 'survival') AND ('relig*' OR 'spirit*' OR 'church' OR 'mosque' OR 'synagogue' OR 'temple' OR 'worship' OR 'pray*' OR 'meditation') AND ('longitudinal' OR 'prospective').

Study Selection

We limited the current systematic review and meta-analysis to prospective studies. Cross-sectional and retrospective case-control studies are subject to recall bias and cannot conclusively identify the temporal association between predictors and outcome variables. In the previously mentioned review by Hill et al. [2], the different aspects of religiosity/spirituality investigated were assigned to the following broad categories: (1) organizational activity (involvement in religious community, including attendance at services); (2) religious social support; (3) nonorganizational activity (prayer, meditation, or sacred book study); (4) intrinsic aspects of religiosity and spirituality (such as belief in a god concept, religious/spiritual well-being, religious/spiritual experience, and religious motivation/orientation); (5) actual coping based on religiosity/spirituality; (6) multidimensional aspects of religiosity/spirituality (measures that included more than one of the above content areas). Criteria for inclusion were as follows: (1) English language full-length publication in a peer-reviewed journal; (2) prospective cohort design; (3) investigating a longitudinal association of religiosity/spirituality with mortality; (4) if more than one kind of religiosity/spirituality or cause of death were assessed in one paper, the samples were included separately. The criteria for exclusion were as follows: (1) the studies that used religious affiliation or denomination (e.g. Christian, Jewish, and Muslim) alone, because membership status alone cannot reliably represent an individual's beliefs, motivations, and behaviors; (2) studies investigating death by suicide, injury, or accident, because the present review principally focused on physical disease-related death; (3) If a cohort was analyzed in more than one publication, the paper with the shorter follow-up, smaller sample size, or poorer study quality was excluded.

Data Extraction and Quality Assessment

A manual was prepared for coding the studies. The manual was revised during the coding to incorporate important aspects of the located studies. We assessed all manuscripts for their quality, since this can contribute to the potential bias associated with the effect estimation. Our quality items were based on existing protocol [16]. We considered a study to be of good quality if it used: (1) consecutive or random recruitment of participants or representative populations; (2) ascertainment of explanatory variables by validated instruments or clinical examination; (3) ascertainment of outcome variables by validated instruments or clinical examination; (4) control for possible covariates, including age, sex, smoking, alcohol consumption, body mass index or physical activity level, and socioeconomic status, and, in the case of a disease population, further inclusion of basal disease status and medical treatment. We classified studies arbitrarily into high- or low-quality categories by whether or not they fulfilled 3 or more of these criteria.

Study inclusion and data extractions were conducted by 1 author (Y.C.) and verified by another (A.S.). Assessments of quality and validity were made independently by at least 2 reviewers. Disputes were settled by consensus.

Data Synthesis and Analysis

We employed random-effects modeling [18] to meta-analyze the data, because the effects of a wide range of religiosity/spirituality measures were compared. Random-effects models are used in meta-analysis in which both within-study sampling error (variance) and between-studies variation are included in the assessment of the uncertainty (confidence interval, effects of a wide range of psychological predictors, etc.) of the results of a meta-analysis. When primary sources provided insufficient data, we obtained them by other means, such as personal communication with the author or from indirect calculation. Hazard ratios (HR) or relative risks (RR) were calculated as measures of effect size. In each case, HR or RR were transformed by taking their natural logarithms (ln) and standard errors were calculated from ln (RR) or ln (HR) and corresponding 95% confidence intervals (CI). Differences in sample size or study quality score between all studies and those included in the meta-analyses were analyzed by Student's t test. The χ^2 test was used to analyze differences in categorical characteristics. Separate meta-analyses were carried out on studies of healthy populations and prognostic studies of people with diagnosed diseases. Provided there was sufficient information (2 studies or more), we aimed to perform sensitivity analyses according to the characteristics of study population (sample size, follow-up period, old population, and gender), study quality score, religiosity/spirituality aspect, and mortality types (all-cause mortality, cardiovascular disease, cancer, respiratory disease, and digestive disease). Unfortunately, there were insufficient studies to carry out subanalyses of younger populations, religious social support, religious/spiritual coping in healthy populations or intrinsic aspects of religious belief in diseased populations. We simultaneously employed the Q-test for homogeneity between studies, which tests whether the between-study variability in effect sizes exceeds that expected from corresponding within-study variability. In all analyses, we used HR and RR from multivariate models with the most complete adjustment for potential confounders. Finally, to detect publication biases, we measured the degree of asymmetry by using Egger's unweighted regression asymmetry test [19] and the fail-safe number [20]. The fail-safe number estimates the number of nonsignificant unpublished studies that would need to be added to a meta-analysis to reduce an overall statistically significant observed effect to nonsignificance [21]. All analyses were performed using a meta-analysis program [22].

Results

Figure 1 shows details of the flow diagram for this present systematic review. Tables summarizing the 36 articles that were included are available from the first author [23–59]. Articles were excluded because they overlapped in their study samples with articles that were included [60–67], because they did not include a relevant spirituality/religiosity predictor variable [68–78], or because the outcome was not assessed in terms of mortality [79–81]. Table 1 summarizes the detailed characteristics of the 69 studies investigating the effect of religiosity/spirituality on mortality in initially healthy populations that were included in the analysis, and the 22 studies investigating the effect of religiosity/spirituality on mortality in diseased populations.

Study Characteristics and Quality

Results from 69 studies of healthy study samples and 22 studies of patients with a diagnosed disease were published between 1977 and 2008. Compared to the disease studies, the healthy population studies involved larger samples, and a higher proportion had a follow-up period. Organizational activity (50/69 studies, 72.5%) was principally evaluated in the healthy population studies. By contrast, other religiosity/spirituality aspects were assessed more in disease than healthy populations. Regarding specific causes of death, all-cause mortality and cancer were assessed in both the healthy and disease studies. Cardiovascular disease, respiratory disease, and digestive disease mortality were only investigated in the initially healthy population studies, while mortality due to renal failure was assessed in the disease studies. The study quality score (0–4) of the healthy studies (average = 2.61) was higher than that of the disease studies (average = 1.85) (table 1).

Study Results and Meta-Analysis

In the healthy population studies, the proportion demonstrating a significant protective effect of religiosity/spirituality on mortality was 39.1%, compared with 22.7% in the disease studies (table 1). Only 3 studies (4.4%) of healthy populations showed a harmful effect of religios-

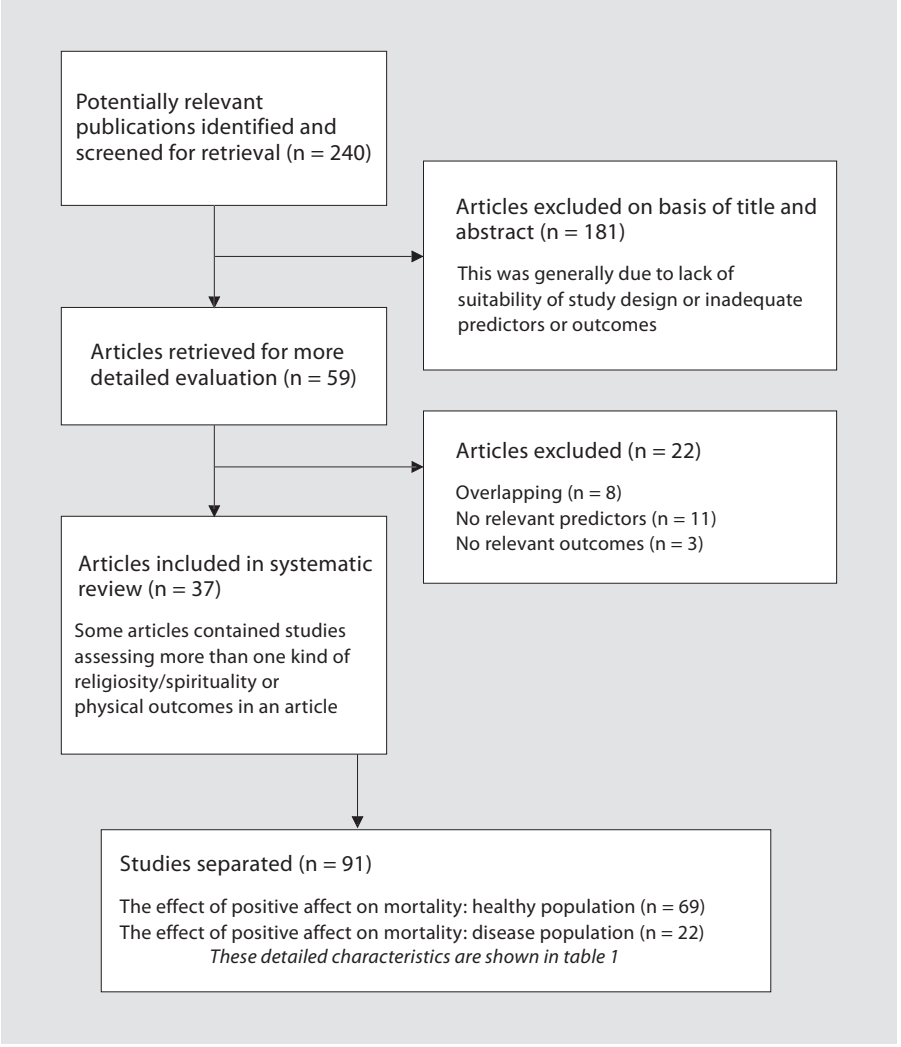

Fig. 1. Flow diagram of systematic review (the quality of reporting of meta-analyses statement flow diagram).

ity/spirituality on mortality. Null effects were observed in 56.5 and 77.3% of the healthy and diseased populations, respectively. The present meta-analyses were limited to only those studies that provided sufficient data to calculate effect sizes. However, there were no significant differences in study characteristics between all the studies identified and the meta-analyzed studies (table 1).

As shown in figures 2 and 3, overall combined HR were 0.82 (95% CI = 0.76–0.87) for the healthy population studies and 0.98 (95% CI = 0.94–1.01) for the disease studies, suggesting a protective effect of religiosity/spirituality on the mortality in the general population. These overall findings were accompanied by significant heterogeneity between studies and by publication bias of Egger's unweighted regression asymmetry test. However, the fail-safe number was 4,881 for the healthy population study analysis, so it was sufficiently high to imply a reliable association. The subgroup meta-analyses showed that the healthy population studies with larger sample sizes (≥1,500) had a lower combined HR (0.80, 95% CI = 0.74–0.87) than the overall effects, but the studies with the longest follow-up periods (≥20 years) exhibited higher combined HR (0.84, 95% CI = 0.74–0.95). The healthy population studies with older people (≥60 years old) or women showed a lower combined HR than the overall effects (HR for older population = 0.79, 95% CI = 0.69–0.90; HR for women = 0.70, 95% CI = 0.55–0.89).

Importantly, the meta-analyses by quality scores demonstrated significant religiosity/spirituality effects without publication bias in the higher quality healthy population studies (HR = 0.82, 95% CI = 0.76–0.88). In the meta-analyses of studies that controlled for behavioral

Table 1. Characteristics of the included studies and meta-analyzed studies

Characteristics	Healthy population		Diseased population	
	whole	meta-analysis	whole	meta-analysis
Total studies	69 (100)	44 (100)	22 (100)	13 (100)
Cohorts	24	15	11	7
Sample size	2,774 ± 496	2,750 ± 674	450 ± 101	485 ± 155
Follow-up period (≥5 years)	52 (75.4)	36 (81.8)	5 (22.7)	5 (38.5)
Quality score	2.61 ± 0.15	2.84 ± 0.16	1.85 ± 0.22	1.85 ± 0.28
Acceptable recruitment	39 (56.5)	25 (56.8)	6 (27.2)	3 (23.1)
Acceptable explanatory variable ascertainment	60 (87.0)	41 (93.2)	18 (81.8)	11 (84.6)
Acceptable outcome variable ascertainment	53 (76.8)	38 (86.4)	12 (54.5)	9 (69.2)
Acceptable control of covariates[1]	36 (52.2)	24 (54.5)	1 (4.5)	1 (7.7)
Religiosity/spirituality category				
Organizational activity	50 (72.5)	33 (75.0)	5 (22.7)	2 (15.4)
Religious social support	1 (1.5)	0 (0.0)	1 (4.5)	1 (7.7)
Nonorganizational activity	7 (10.1)	4 (9.1)	5 (22.7)	3 (23.1)
Intrinsic aspects	6 (8.7)	4 (9.1)	3 (13.6)	1 (7.7)
Religious/spiritual coping	1 (1.5)	0 (0.0)	4 (18.2)	4 (30.8)
Multidimensional aspects	4 (5.8)	3 (6.8)	4 (18.2)	2 (15.4)
Mortality				
All-cause mortality	47 (68.1)	27 (61.4)	9 (40.9)	6 (46.2)
Cardiovascular disease	7 (10.1)	6 (13.6)	–	–
Cancer	6 (8.7)	5 (11.4)	8 (36.4)	4 (30.8)
Respiratory disease	4 (5.8)	3 (6.8)	–	–
Digestive disease	3 (4.4)	3 (6.8)	–	–
Renal failure	–	–	2 (9.1)	0 (0.0)
Others	2 (2.9)	0 (0.0)	3 (13.6)	3 (23.1)
Effect of religiosity/spirituality on mortality				
Protective (significant)	27 (39.1)	16 (36.4)	5 (22.7)	2 (15.4)
Null (not significant)	39 (56.5)	28 (63.6)	17 (77.3)	11 (84.6)
Harmful (significant)	3 (4.4)	0 (0.0)	0 (0.0)	0 (0.0)

Values presented as averages ± SE; figures in parentheses are percentages. 'Whole' and 'meta-analysis' indicate all of the enrolled studies and the studies providing sufficient data to calculate effect sizes, respectively.

[1] Including age, sex, smoking, alcohol, BMI or physical activity, and socioeconomic status (in the case of disease population, age, sex, smoking, alcohol, BMI or physical status, basal disease status, medical therapy, and socioeconomic status).

covariates, negative affect or social support, the protective effect of religiosity/spirituality remained significant in the healthy populations (HR for behavioral covariates = 0.85, 95% CI = 0.79–0.92; HR for negative affect = 0.87, 95% CI = 0.81–0.93; HR for social support = 0.84, 95% CI = 0.78–0.91).

Differences were observed between the religiosity/spirituality aspects. In the healthy population studies, organizational activity and multi-dimensional aspects were more strongly associated with decreased mortality than the overall effect (HR for organizational activity = 0.77, 95% CI = 0.71–0.83; HR for multi-dimensional aspects = 0.55, 95% CI = 0.38–0.80). The analyses of different causes of death demonstrated that religiosity/spirituality was associated with reduced all-cause mortality (16% reduction in HR) and cardiovascular mortality (28% reduction in HR) in the healthy population studies. Two of the studies [42, 44] with cardiovascular outcomes were not controlled for any factors apart from age and sex. We therefore repeated the meta-analysis on cardiovascular mortality excluding these studies, where the result still remained significant (HR = 0.83, 95% CI = 0.71–0.97, p = 0.022). There were insufficient studies to carry out many of the sensitivity analyses of studies of diseased popula-

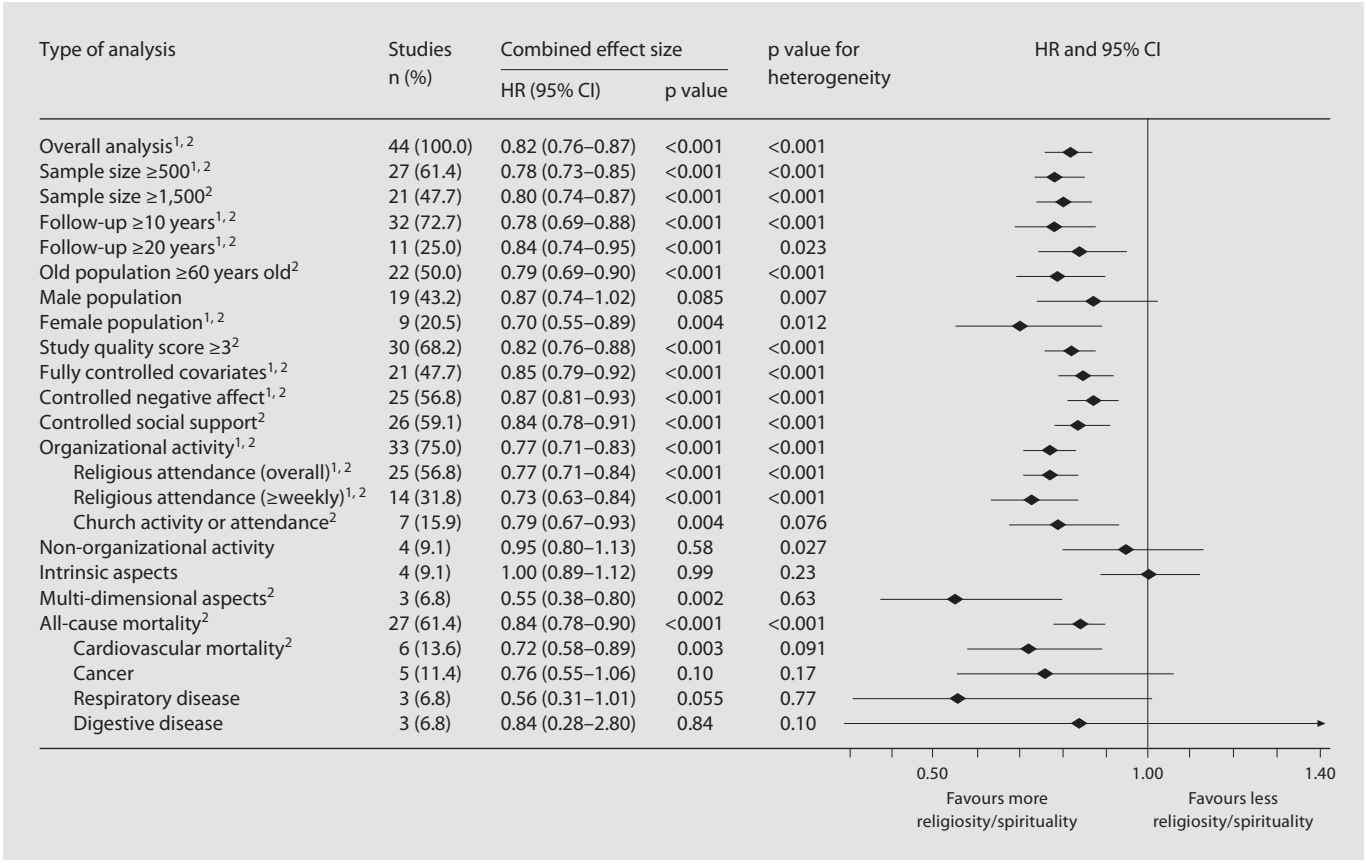

Fig. 2. The effect of religiosity/spirituality on mortality in healthy populations (results of meta-analyses, subgrouping, and sensitivity analyses). [1] Publication bias assessed by Egger's method is significant ($p < 0.10$). [2] Combined effect size is significant ($p < 0.05$).

tions. Nevertheless, we found that in diseased populations, there was a stronger protective effect in studies that assessed multi-dimensional aspects of religiosity/spirituality, rather than other aspects (HR = 0.50, 95% CI = 0.26–0.97). Several subgroup analyses were accompanied by significant heterogeneity and publication bias (fig. 2, 3).

Discussion

To our knowledge, this is the first review to show the protective effect of religiosity/spirituality on mortality due to cardiovascular disease. Prospective observational epidemiological studies cannot confirm causality, since there may be residual confounders or unmeasured factors that contribute both to religiosity/spirituality and mortality. Although major confounders were addressed, it is conceivable that other factors such as upbringing or personality could attract people towards religion and spirituality, and might also have effects on health. If such an association is genuine, it could be mediated in part via behavioral pathways. For example, more religiosity/spirituality is thought to be related to healthier behavior, including less smoking, exercising, drinking moderately, lower dietary fat intake, and better sleep quality [15, 82]. However, the protective effect of religiosity/spirituality on mortality in healthy population studies persisted even after controlling for major behavioral covariates. Another potential interpretation is that religiosity/spirituality contributes to reduced mortality by buffering psychological distress or by increasing social support [8, 15]. Nevertheless, the persistence of associations in meta-analyses of studies that controlled for negative affect or social support suggests that the protective effect of religiosity/spirituality on mortality is at least partly independent of neg-

Type of analysis	Studies n (%)	Combined effect size		p value for heterogeneity	HR and 95% CI
		HR (95% CI)	p value		
Overall analysis[1]	13 (100.0)	0.98 (0.94–1.01)	0.19	0.033	
Sample size ≥250	8 (61.5)	1.00 (0.99–1.01)	0.39	0.43	
Sample size ≥500	4 (30.8)	0.98 (0.96–1.01)	0.20	0.084	
Follow-up ≥2 years	8 (61.5)	1.00 (0.99–1.01)	0.98	0.70	
Follow-up ≥5 years	5 (38.5)	1.00 (0.99–1.01)	1.00	0.99	
Male population	2 (15.4)	0.79 (0.38–1.61)	0.51	0.11	
Female population[1]	4 (30.8)	0.96 (0.73–1.25)	0.75	0.58	
Study quality score ≥3	3 (23.1)	1.00 (0.99–1.01)	1.00	0.98	
Organizational activity	2 (15.4)	0.71 (0.32–1.57)	0.40	0.12	
Non-organizational activity	3 (23.1)	1.03 (0.86–1.23)	0.78	0.89	
Religious/spiritual coping	4 (30.8)	0.98 (0.96–1.01)	0.20	0.08	
Multi-dimensional aspects[2]	2 (15.4)	0.50 (0.26–0.97)	0.004	0.77	
All-cause mortality[1]	6 (46.2)	0.98 (0.95–1.01)	0.20	0.053	
Cancer	4 (30.8)	1.01 (0.89–1.15)	0.88	0.96	

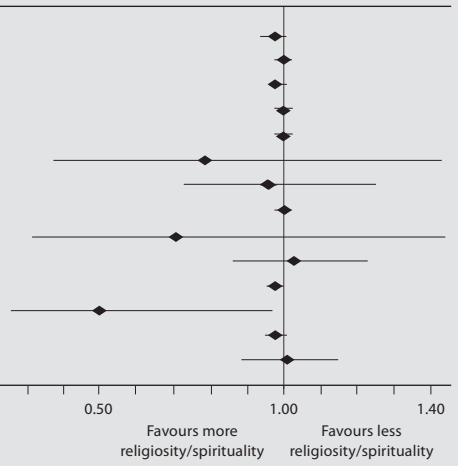

Fig. 3. The effect of religiosity/spirituality on mortality in diseased populations (results of meta-analyses, subgrouping, and sensitivity analyses). [1] Publication bias assessed by Egger's method is significant ($p < 0.10$). [2] Combined effect size is significant ($p < 0.05$).

ative affect and social support. Alternatively, direct physiological pathways might also be involved. Religiosity/spirituality might attenuate sympathetic nervous system activity and enhance parasympathetic activation, leading to decreased blood pressure [31, 83], or may reduce inflammatory cytokine levels [27, 84]. In some studies, religiosity/spirituality has also been related to lower circulating cortisol levels or cortisol responsiveness [85–87], and may thereby contribute to reduced risks for a range of health outcomes. It is also possible that religiosity/spirituality may be associated with reduced mortality by increasing positive affects such as happiness, life satisfaction, and cheerfulness [88–91].

The subgroup analyses showed stronger effects in studies with larger sample sizes for healthy populations, but not in the studies with the longest duration. Generally, the cohort studies with larger sample sizes and longer follow-up periods are considered stronger, because these designs increase the power to detect any differences between the control and exposed groups. However, it cannot be assumed that religious and spiritual activity is constant, and there may have been changes in levels of activity over the years that diluted effects in longer term studies. Study quality is also important [92]. We conducted subgroup meta-analyses on studies with a high quality score (≥3), in order to reduce potential bias associated with the effect estimation, and our results confirmed robust associations between religiosity/spirituality and reduced mortality in healthy population studies.

There was a striking difference between the results for healthy populations and studies of people with serious illnesses. The lack of association between religiosity/spirituality and mortality in the latter may have several explanations. It is possible that once diseases are established, identified, and treated, religiosity/spirituality has little impact on outcome. Religiosity/spirituality may be more important in promoting resistance to health problems before they have reached an advanced stage. Another possible explanation is that the wrong aspects of religiosity/spirituality have been studied in diseased populations. It is notable that in healthy population studies, the most favorable effects emerged for organizational activity, including religious attendance. Only 2 studies of diseased populations investigated organizational activity, and the majority focused on religious or spiritual coping and nonorganizational activity. It should also be noted that religious coping is frequently cited as a method of coming to terms with disease [15, 53], but it can have both positive and negative connotations. Negative religious coping (such as passive religious deferral and pleas for direct intercession) may be harmful, offsetting any beneficial effects in these studies. Methodological factors

may also have contributed. Study quality was far less good in studies of diseased populations, with only 23.1% of studies fulfilling our quality threshold (≥3).

The analyses of religiosity/spirituality aspects found that multi-dimensional aspects were associated with significantly reduced mortality in both the healthy and disease population studies, whereas organizational activity was only significant in the healthy population studies. Very few studies investigated multi-dimensional aspects, so these results must be interpreted with caution. Nevertheless, the finding suggests that a combination of several possible religiosity/spirituality aspects, rather than a single central factor, may have a more robust role in influencing mortality in both healthy and diseased populations. Religious attendance has been proposed as the main driver of positive effects in studies of organizational activities [10]; indeed, we showed that religious attendance at least weekly had a stronger protective effect on mortality in healthy populations (HR = 0.73, 95% CI = 0.63–0.84) than did organizational activity in general (HR = 0.77, 95% CI = 0.71–0.83), suggesting that frequent attendance might play a critical role in mortality. The attendance effect related to all faiths. The protective effect on mortality of Christian church activity or attendance (HR = 0.79, CI = 0.67–0.93) was quite similar to that of organizational activity in general, suggesting that this effect may not be restricted to Christian faiths alone.

Our review has several limitations. Firstly, it was limited to the evaluation of results in published papers. We found evidence of publication biases in the overall effect and in some of the subanalyses by Egger's unweighted regression asymmetry test. This may imply a positive result bias if authors are more likely to submit, or editors accept, positive than null (negative or inconclusive) results. However, the fail-safe number in the overall analysis of healthy population studies was sufficiently high that a very large number of nonsignificant studies would have to be in the 'file drawer' to negate the significance of the association. It is also worth noting that the method of grouping religiosity/spirituality levels was inconsistent across studies, with some using binary divisions, others tertiles or quartiles, or arbitrary cutoff scores, although we evaluated the validity of religiosity/spirituality measurement in each study as a quality score.

In conclusion, this meta-analysis suggests that religiosity/spirituality has a favorable effect on survival. Additional research is needed to clarify which aspects are most important, and to examine to what extent aspects of religiosity/spirituality aspects can potentially enhance public health and elevate patients' resistance to disease.

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